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Electromagnetic Fields As An Element of Spacecraft Construction

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Abstract*: The article suggests the best option for designing a spacecraft. The process of activity of proposed structure of a spacecraft in outer space must be based on the acceleration due to the electromagnetic fields of the Solar System and the Milky Way Galaxy. Purpose of the study. Suggest a design solution to create a model of a spacecraft that is accelerated in motion using space electromagnetic fields. The relevance of the chosen topic is based on the need to address issues related to the limited resources of the planet, significant levels of overpopulation, problems of demography, ecology, sociology and political life. Novelty. It is determined that in order to obtain calculations of the acceleration of 1 g of spatial arbitrary direction, it is necessary to make measurements along the chain and to deduce the amount of charge on the useful surface of the object. Methodology. Magnetic field strength measurement method, electromagnetic measurement method. Results and conclusions. The article presents a scheme of creating a modified magnetic type engine, the result its process of activity will be an acceleration of 0.05 g. It will be achieved by free movement in outer space with the appropriate current.

***Keywords* : Electromagnetic fields; Spacecraft construction; Surface charge; Lorentz force; Process of activity, Magnetic field strength.**

I. INTRODUCTION

The analyzed scheme of the spacecraft was previously proposed by scientists A.V. Lemeshko [6] and R.J. Gayduk [7, 8], but, unfortunately, has not found its scientific continuation at the international level.

There are also recent scientific studies that suggest paying attention to error-making by building an aircraft for outer space. This is, in particular, the study of foreign scientists G. Ramanan, F. Aaron Raphael Raja, K. Samuel Diwan Vivek [13], M. Leomanni, A. Garulli, A. Giannitrapani, F. Scortecci [15].

In some scientific works it is suggested to focus on auxiliary design elements, for example, prediction of parameters of machining processes using artificial neural network (in works of G. Ramanan, Edwin Raja Dhas, KS Jai Aultrin [12]), simulation of the motion of charged particles in a relative impulse plasmas in the initial stage (in works of A. Antipov, A. Bogatyy [14]), uncertainty optimization algorithms for the design of fractionated spacecraft (in works of Xin Ning, Jianping Yuan, Xiaokui Yue [16]), the flexibility estimation provided by fractionated spacecraft (in works of C. Mathieu, A. Weigel [17]), optimal algorithms for prediction (in works of Y. Shang, J. Zhang, Z. Wang [18]), trajectory design (in works of M. Ceriotti, J. Heiligers, C. R. McInnes [19]), network mission system (in works of T. Takashima, E. Ogawa, K. Asamura, M. Hikishima [20]), optimization of spacecraft design parameters Low Earth Orbit (in works of S. A. Ishkov [21]), a multidisciplinary design optimizer for spacecraft (in works of V. Lau, F. Sousa, R. L. Galski, E. M. Rocco, J. C. Becceneri, W. Santos, S. A. Sandri [22]), artificial intelligence (in works of D. Izzo, M. Märtens [23]), binfeng pan objects (in works of A. Mereta, D. Izzo, A. Wittig [24]) and continuous thrust trajectories (in works of B. Dachwald, A. Ohndorf [25]).

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II. METHODOLOGY

It is proverbially [4] that the Earth's magnetic field has an inductive field expressed by the formula $30 \times 10^{-6} T$, which has an average value that differs on various points on the planet). The Sun also has a magnetic field, expressed by the formula: $4000 Gs = 4000 \times 10^{-4} T = 0.4 T$, the average value for the field of the Solar System and the Milky Way Galaxy is expressed by the $3 \times 10^{-6} Gs = 3 \times 10^{-10} T$.

Such indicators show the need for the construction of a spacecraft, the mechanism of operation of which will be based on a continuous stream of magnetic fields of planets, star systems, galaxies, as in the above examples.

We offer a model of a spacecraft with the following parameters: 0.1 kg - weight, 0.1 m - useful chain diameter. Arrange them according to the scheme [Fig.1]:

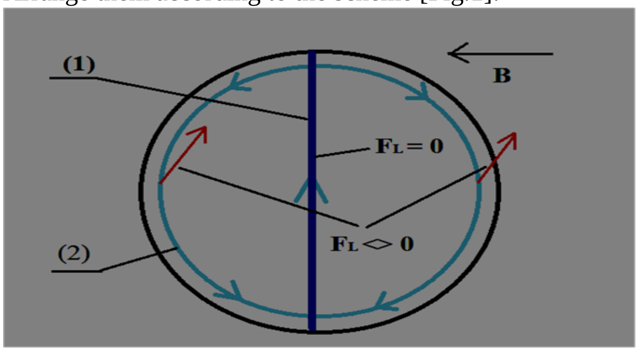

Fig. 1. **B – the magnetic field vector, F_L – the Lorentz force, (1) – the part of the current-carrying conductor covered with a ferromagnetic material, (2) – the current-carrying conductor**

III. RESULT AND DISCUSSION

With this arrangement, the obtained Lorentz force presses up, respectively, defining the force for levitation so that the spacecraft could move in open space.

Perpendicular turn of the chain in Fig. 1 regarding the location of the magnetic field B will give the structure an acceleration, but only in the direction of the perpendicular. The resulting acceleration will not extend to the rest of the coordinate planes.

The minimum amperage for such an action must be calculated as follows:

Lorentz force [1]:

F_L=B × I × L=B × I × π × D=m × g - Newton's force (gravity)

we will have from here that:

$$I=\frac{m\times g}{B\times\pi\times D}=\frac{0.1\times10}{30\times10^{-6}\times3.1415\times0.1}=10^5[A].$$

For vertical acceleration of 1 g, the current strength shall comprise $2\times10^5 A$ accordingly.

The formula for calculating a flight in one day will look like this:

$$V_1=V_0+a\times t=0+10m/s^2\times60s\times60\times24=864[\text{km}/s].,$$

where will be given the amperage and acceleration by zero initial velocity value.

Magnetic field of galaxy and medium induction with value $3\times10^{-10}T$ will allow the calculation for the magnetic field outside the Solar System.

Under these conditions, gravitational forces in the Galaxy assume a value of zero, which is not true at all. Acceleration will require the following current on the circuit:

$I=\frac{10^5\times30\times10^{-6}}{3\times10^{-10}}=10^6\times10^4=10^{10}[A]$ or 10 billion amperes.

Such strength can be achieved by installing 100,000 parallel conductors with force $10^5 A$ each.

Open space allows the use superconductors.

Zero initial velocity will determine the same speed of the spacecraft in a day by $864\ \text{km}/s$ and six months $864\text{km}/s\times183=158{,}112\ \text{km}/s$ according to such indicators, respectively.

This speed will affect the weight of the astronaut and it can be determined by the formula [3]:

$$m=\frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}},$$

This number corresponds to 1.15 weight on Earth. So, a person who weighs 75 kg on Earth will weigh 86 kg in the apparatus. This corresponds to the rate of calculation. Considering all these figures, it will take 9 years one way to travel to Proxima Centauri (subject to acceleration of up to 0.5 speeds of light and six months to slow down). The challenge is to move in any direction in R^3 is unexplored because it rests on the perpendicular to the Lorentz force and the magnetic flux lines.

Even magnetizing the surface of the apparatus (to maintain positive and negative potentials) and adding some other sources of magnetic field will not solve the delay for movement in the direction in R^3 the third law on Newton's motion will cease to apply.

Supporting positive and negative or free electrons on the surface can accelerate motion in the galaxy's electric field. However, there is very little research on this. From the results of the available measurements, it is known that the power of the solar system varies from unities to several thousand microvolts per meter [5].

Therefore, the design shown in Fig. 2 will produce acceleration of electrostatic lines of force to increase or decrease the potential by using either free electrons or a positive charge on the surface [*Fig.* 2]:

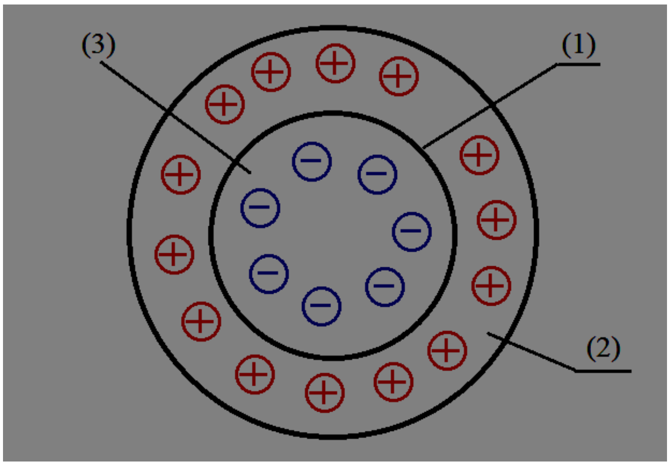

***Fig. 2.* (1) – a dielectric, (2) – a positive charge on the surface, which interacts with an electric field, (3) – a negative charge under dielectric material**

Therefore, the acceleration under these conditions will have such indicators [2]: $a=q\times\frac{E}{m}$, where q – the total charge on the surface, m – the weight of the spaceship, E – the electric field strength (for example, it may be equal to $5\times10^{-6}\ V/m$). Therefore, our test model weighing 0.1 kg in order to obtain an acceleration of 1 g must conform to this formula $q=m\times\frac{a}{E}=0.1\times\frac{10}{5\times10^{-6}}=2\times10^5$ and have a Coulomb value.

If we apply the specimens of the apparatus from both figures, a space ship with open acceleration of 1 g in any direction (except the points of intersection of perpendiculars) will be obtained.

An atomic power station by an atomic energy converter can be used to generate energy to maintain the current in the motor in Figs. 1 of the required charge in the engine in Fig. 2. It will act as a generator.

Consider the design in Fig. 1. This design can be replaced by a solenoid, where each coil will have the following form:

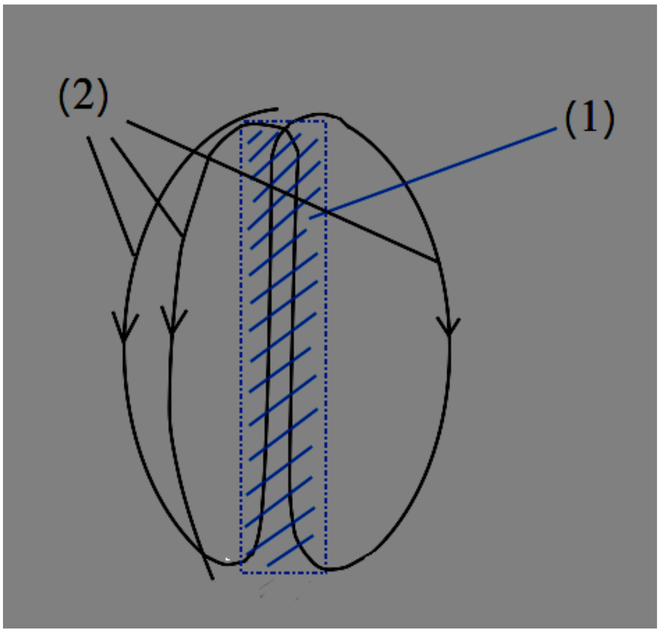

Fig. 3. **(1) – the ferromagnetic part of the current-carrying conductor, (2) – the current-carrying conductor**

he Lorenz force that will press will be calculated as follows: $F_r = B*I*\pi*D*N$, where N denotes the number of spiral turns.

From the scientific work [9] we have information that a solenoid with a length of 1 m has a maximum number of turns equal to 400.

To calculate how many solenoids it takes to install at the bottom of a spacecraft with a diameter of 3.5-4 meters, it is necessary to install 12 solenoids with a diameter of 1 meter and a length of 1 meter.

The power of the current in such a wire will matter $I = \dfrac{m*g}{B*\pi*D*N*12} = 20800\left[amperes\right]$ in order to provide an acceleration of 1 g with the weight of the entire spacecraft 1000 kg.

The received current can stay in the engine for a very long time. Therefore, the weight of the wire in the first table will be approximately 490 kilograms. Accordingly, more than 500 kilograms will remain for the construction of the spacecraft and additional cargo.

The Earth's charge [10] $6.6*10^5 C$ is necessary to calculate the levitation charge on the surface in an electric field of the Earth at a value of vertical acceleration of 1 g, which will compensate for the force of attraction.

The received current can stay in the engine for a very long time. Coulomb's law will help to describe the required charge on the surface, which is calculated by the formula:

$$q = \frac{m*g*R^2}{k*Q} = 70C$$

In this formula, letters take on a value
g – the force of gravity,
R is the radius of the Earth in meters,
k is a coefficient equal to:

$9*10^9 \dfrac{N*m^2}{C^2}$, Q is the charge of the Earth,

m is the weight of the apparatus.

In the analyzed apparatus, where the motor operates in a non-zero charge, except for the action of Coulomb law, the Lorentz force arises. It affects the moving charged particle in a magnetic field. This is the reason to consider the Lorentz force of the current conductor, the Lorentz force of the charged particle, and the Coulomb force when we calculate the value of the velocity vector.

It is a well-known fact that the flight to New York-Sydney takes about 22 hours. We will provide the aircraft with the characteristics described and then an acceleration of 1 g during deceleration and halfway, the journey will not exceed 1 hour and its maximum speed will be 17.8 km / s in the middle of the trip.

Let's analyze the ship described above. It is known that cosmic electromagnetic fields are weaker than electromagnetic fields of the Earth.

The value of magnetic field induction will be described by the formula: $3*10^{-10}T$

The described design will look like in the Fig. 4

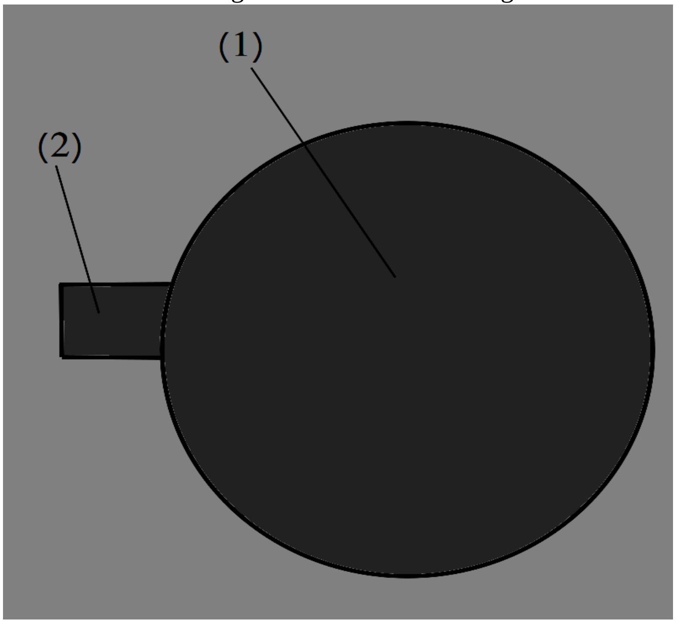

Fig. 4. **(1) shows the engine compartment with Lorenz force, (2) - housing compartment**

Let the parameters be as follows: the diameter of the engine compartment with Lorenz force will be 30 meters, its weight is 50 tons, the weight of the housing compartment together + the load will also be 50 tons. The solenoid in Fig. 3 has a length of 1 meter and a diameter of 1 meter. The lightest conductors weighing 3 kg per kilometer are used to build the aircraft.

From these data, we can see that the engine compartment with Lorenz force can include at least 15 * 15 * 2 * 15 = 6750 such solenoids of 400 turns each. Their weight will vary from 6750 * 1 * 3,14 * 400 * 3/1000 = 25 tons. The rest of the weight will be distributed to the design needs.

Therefore, the current in the solenoid will be calculated by the following indicators:

$$I = \frac{m*g}{B*\pi*D*N*6750}\ amperes$$

$$I=\frac{100*1000*10}{3*10^{-10}*3.14*1*400*6750}\,amperes$$

$$I=40*10^{7}\,amperes$$

The maximum number of superconducting currents in the laboratory will have the number of $10^{7}\,amperes$. This indicator makes it possible to say that a space engine can be created if the following parameters are observed: increasing or decreasing the maximum force under the influence of high temperatures for a long time.

It is also possible to consider an example where the wire is 1 m long and weighs 0.003 kg. if the amperage is $10^{7}\,amperes$, the acceleration of the conductor in space will be equal to:

$$a=\frac{I*B*L}{m}\frac{m}{sec^{2}}=\frac{10^{7}*3*10^{-10}*1}{0.003}\frac{m}{sec^{2}}=0.1\,g$$

If the added value of the payload on 0.003 kg, the device will receive acceleration 0.05 g.

That is, according to the above formulas it can be argued that the correct design will allow to obtain favorable acceleration in outer space.

Thus, with the specified acceleration, the flight to Mars will last more than a week, and to Proxima Centauri - about 18 years.

It is generally accepted that a magnetic field is present in every galaxy. And no exception is the Milky Way and Andromeda Nebula, which is located at 2.5 million light years and has a size of 220 thousand light years.

The Earth has a diameter of 12 742 kilometers, and the distance from the center of the planet to the boundaries of its magnetosphere is 70,000 kilometers.

By these indicators we can assume that their magnetic fields intersect. Therefore, the vector discussed above is the result of a superposition of two vectors - the magnetic field of the Andromeda Nebula and the Milky Way Galaxy.

It is well known that with the help of a screen made of ferromagnetic material, the Lorentz force can be extracted separately for each of the vectors.

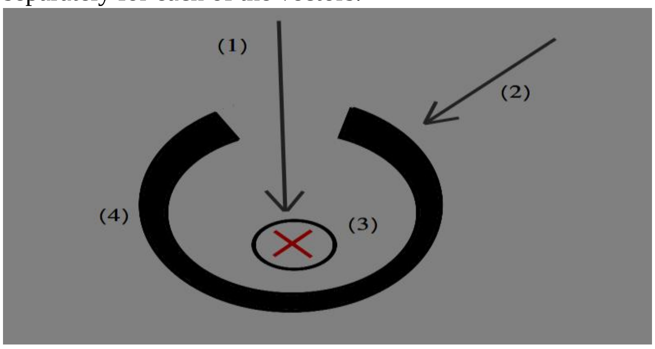

***Fig. 5.* The first is the magnetic field of the Milky Way Galaxy with induction B_1 with current-carrying conductor's interaction, the second is the magnetic field of the Andromeda Nebula B_2 without current-carrying conductor's interaction, the third is the current-carrying conductor, the fourth is the Ferromagnetic material screen.**

Then the first indicator is not equal to zero: $F_{L1} \neq 0$, and the second is equal to zero: $F_{L2} = 0$.

You can try projecting different positions of current conductors and openings of ferromagnetic material for B_1 and for B_2 in order to indicators of Lorentz force vectors F_{L1} and F_{L2} for two non-collinear planes with absolute magnitude with different values of vectors.

Such sets of vector sums of vectors will cover all directions and solve the space problem of acceleration 0.05 g.

The above calculations may be valid for use in other galaxies, such as the Large and Small Magellanic Clouds. In these, we can calculate for two noncollinear planes with different values of vectors in absolute value. Galaxies are in this list [11].

The proposed calculations may be useful in orbital freight. It is well known that the equatorial lines of the Earth's magnetic field are parallel to its surface, that is, the area of action of the Lorentz force vector is perpendicular. To construct a cosmodrome on the Equator, it is necessary to choose the location of solenoids that will make the Lorentz force perpendicular to the Earth's surface. Then we will increase the Earth's magnetic field induction factor by 5 times and we will be able to offer a spacecraft design in which the vertical acceleration will be 0.05 g * 100 000/1000 - g = 4 g at a current of 10 thousand amperes or a vertical acceleration of 1 g at a current of 4 thousand amperes.

IV. CONCLUSION

The method of designing a spacecraft with a propulsion based on the electromagnetic fields of the Galaxy, which is proposed, carried out on a large numerical calculations, which confirm its power in the work. A ship model having validated current values and the engine layout will reach the required speeds, which will be sufficient for flights at an acceptable time.The practical significance of the article is that in the models offered its possible to make calculations for the weight of the crew and luggage. The author proposes to consider the issues of flight duration and difficulties associated with it.

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